

## Snow Water Equivalent SAR and Radiometer (SWESARR)

Completed Technology Project (2016 - 2019)



## Project Introduction

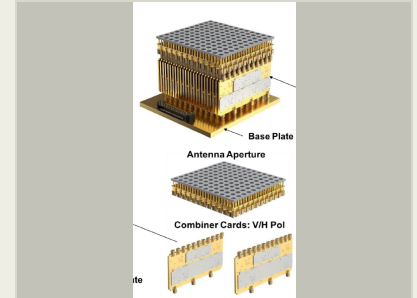
After nearly four decades of international effort developing remote sensing techniques, measurement of land surface snow remains a significant challenge. Developing the tools needed to remotely measure Snow Water Equivalent (SWE) is a priority, as SWE is currently sparsely sampled in-situ, and there is no remote sensing product available for mountainous regions, while spatial SWE estimates are required for current water resource management and climate studies.

Snow Water Equivalent SAR and Radiometer (SWESARR) is a tri-band synthetic aperture radar (SAR) and a tri-band radiometer. The radiometer has been in development through ESTO-IIP funds since 2010. SWESARR radar system development is the focus of current efforts to provide a state-of-the-art microwave snow measurement system. Both the active and passive bands utilize a highly novel current sheet array (CSA) antenna feed. A combination of radar and radiometric measurements spanning this 8-40 GHz spectrum shows great promise for quantifying the geospatial distribution of surface snow.

SnowEx is a multi-year airborne snow campaign that tries to answer a fundamental question: How much water is stored in Earth's terrestrial snow-covered regions? The SnowEx research community wants to fully understand the various techniques, focusing on the challenges presented by forests is the perfect opportunity to collect a unique dataset that will help address the science questions and enable snow mission design trade studies. The goal of this project is to prepare SWESARR to participate in the upcoming SnowEx flight campaigns.

SWESARR is an triple band SAR and radiometer developed through NASA Earth Science Technology Office (ESTO) Instrument Incubator Program (IIP), and Goddard's Internal Research and Development Program (IRAD). The main objective of the proposed work is to develop and demonstrate a tri-band dual-pol SAR sensor; and 2) improve the calibration of SWESARR radiometer for snow-water-equivalent (SWE) inversion. The main objective of this proposal is to do the underlying work to get SWESARR ready for SnowEx flights in years 2019-2021.

Furthermore a new feed is being designed by Harris Corp. and Nuvotronics as a part of an ESTO effort which is expected to be completed in the third quarter of 2017. Upon completion, the antenna will be tested at NASA Goddard Space Flight Center. The new feed and reflector antenna will be integrated to the rest of the radar and radiometer system. Once the integration is complete, the full system will be tested inside the anechoic chamber at NASA Goddard. An important aspect of this effort is the development of several processing steps to assist in going from raw radar echoes to scientific observations.



The wideband antenna feed for SWESARR

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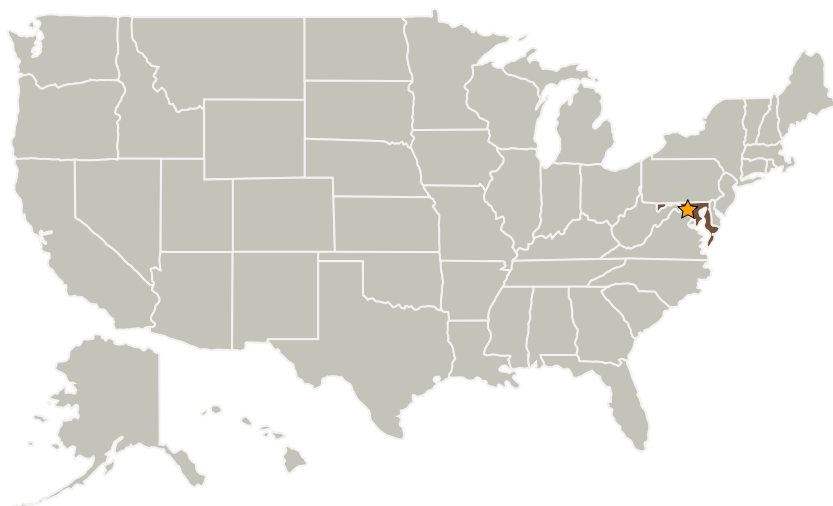
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## Anticipated Benefits

SWESARR will provide co-located active and passive microwave data allowing for the accurate estimation of water stored in snow. Currently the state-of-the-art techniques involve estimating the accumulated snow height and amount of water by using an average snow density. Microwave measurements allow direct inversion of snow water equivalent removing the need of using average density. Furthermore, SWESARR will provide a test-bed for measurement techniques that can be extended to satellite observation, allowing for future missions with large swaths and high resolution.

## Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★ Goddard Space Flight Center (GSFC)	Lead Organization	NASA Center	Greenbelt, Maryland

## Organizational Responsibility

**Responsible Mission Directorate:**

Mission Support Directorate (MSD)

**Lead Center / Facility:**

Goddard Space Flight Center (GSFC)

**Responsible Program:**

Center Independent Research &amp; Development: GSFC IRAD

## Project Management

**Program Manager:**

Peter M Hughes

**Project Managers:**Matthew J McGill  
William E Cutlip**Principal Investigator:**

Batuhan Osmanoglu

**Co-Investigators:**Quenton Bonds  
Paul E Racette  
Rafael Rincon

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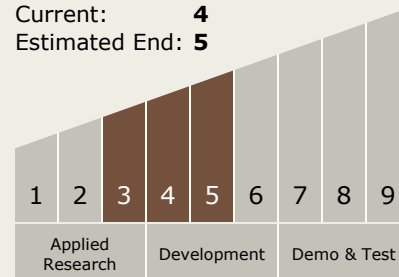
Co-Funding Partners	Type	Location
Boise State University	Academia	Boise, Idaho
Glenn Research Center(GRC)	NASA Center	Cleveland, Ohio
Harris Corporation	Industry	
Nuvotronics, Inc	Industry	Radford, Virginia

## Primary U.S. Work Locations

Maryland

## Technology Maturity (TRL)

Start: **3**  
 Current: **4**  
 Estimated End: **5**



## Technology Areas

## Primary:

- TX08 Sensors and Instruments
  - TX08.1 Remote Sensing Instruments/Sensors
    - TX08.1.4 Microwave, Millimeter-, and Submillimeter-Waves

## Target Destination

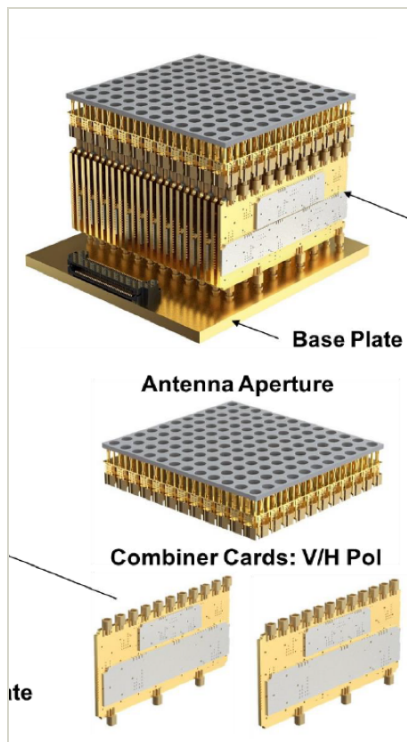
Earth

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### Images



### Snow Water Equivalent Synthetic Aperture Radar and Radiometer

The wideband antenna feed for SWESARR

(<https://techport.nasa.gov/image/34652>)

### Project Website:

<http://sciences.gsfc.nasa.gov/sed/>